Endovascular Repair of a Transected Proximal Brachial Artery

An endovascular approach can provide critically wounded patients with a less-invasive and possibly lifesaving treatment.

BY RICHARD PIN, MD, FACS, RPVI

Vascular surgeons are often consulted to manage complex arterial injuries in trauma patients. Penetrating trauma resulting from stab wounds or gunshot wounds often require surgical intervention to control bleeding or restore blood flow to an ischemic limb. Conventional repair of these types of vascular injuries involves open reconstruction with direct sutures, patch closure, or bypass surgery. As vascular surgeons have adopted endovascular training, however, more surgeons participating in the care of trauma patients are considering endovascular treatment options, similar to how we would evaluate nontraumatic patients for elective vascular procedures.

This transition has become increasingly evident with blunt thoracic aortic injuries, although its utility in penetrating proximal extremity trauma has not been widely evaluated. As with blunt aortic injuries, percutaneous intervention for penetrating proximal extremity trauma offers several potential benefits. With high-energy projectiles, severe surrounding tissue damage can accompany vascular injury, making dissection and control of proximal and distal arteries challenging, particularly when adjacent to nervous structures. Similar to aortic injuries, large incisions in the chest, abdomen, or flank may be needed to obtain adequate vascular exposure for repair of proximal limb vessels. In patients who are severely injured, open surgery with its attendant blood loss and tissue trauma can exacerbate hemodynamic instability for those who are already critically ill.

Conversely, percutaneous intervention has its own limitations, and when its use is applicable, there are also potential drawbacks compared to open vascular procedures. Percutaneous interventions warrant more vigilant follow-up, as they are more likely to require secondary interventions. Endovascular repairs typically require more aggressive antiplatelet therapy than surgical repairs that do not use prosthetic grafts, which may complicate matters in patients with concomitant head injuries or in patients with multiple organ trauma who may need further surgery. Furthermore, when percutaneous interventions are technically unsuccessful, the vascular surgeon must be immediately prepared to convert to an open vascular procedure. In the particular setting of penetrating trauma, the added risk of bacteria seeding an endograft exists and should be appropriately managed. These collective factors must be weighed in individual trauma patients when deciding between a primary endovascular versus open approach. The following case describes the endovascular repair of a proximal brachial artery injury resulting from a stab wound to the shoulder.

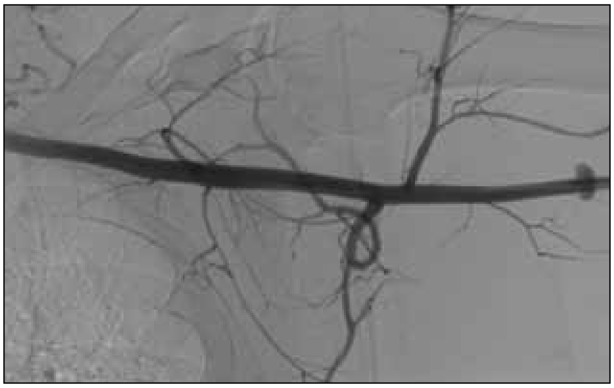

Figure 1. Pseudoaneurysm of proximal brachial artery.

CASE PRESENTATION

The patient is a 49-year-old man who presented to the emergency department with pulsatile hemorrhage from a penetrating knife wound to the left shoulder. Direct pressure was applied to the wound, and external bleeding was controlled. He was slightly hypotensive, with a systolic blood pressure in the 90s, which responded appropriately to fluid resuscitation. Examination of the injury demonstrated a clean 3-cm puncture wound to the superior-posterior aspect of the distal shoulder. The patient weighed 270 lbs

Figure 2. Persistent pseudoaneurysm after placement of 6-mm Viabahn endograft (Gore & Associates, Flagstaff, AZ).

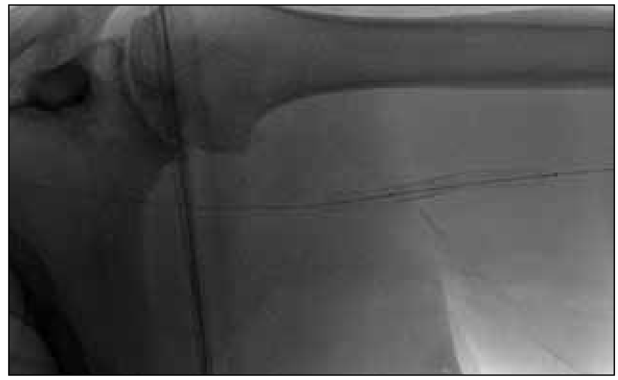

Figure 3. Overlapping 7- and 6-mm Viabahn endografts.

and measured 5'7" in height, and his proximal arm was large and bulky with moderate surrounding hematoma. He underwent computed tomographic scanning of the chest, which showed extravasation of intravenous contrast from the proximal brachial artery at the level of the humeral head. With the location of injury at the shoulder and large arm girth and hematoma, we elected to perform endovascular repair of this injury and avoid direct repair adjacent to the brachial plexus or bypass surgery crossing the shoulder joint.

The patient was brought to our hybrid angiography suite, and a 4-F sheath was introduced into his left brachial artery at the antecubital fossa. We brought a catheter and wire to the presumed area of injury. Angiography demonstrated a pseudoaneurysm of the proximal brachial artery just distal to the shoulder girdle (Figure 1). We heparinized the patient and upsized to a 6-F brachial sheath. The vessel diameter at the level of injury measured 5 mm on computed tomographic scan. We elected to place a 6- X 50-mm Viabahn endograft. The graft was deployed over the injury and ballooned to profile. Repeat angiography demonstrated persistent filling of the pseudoaneurysm sac (Figure 2). The cause of endoleak appeared to be an undersized endograft in the proximal extent of the vessel. We elected to place an additional 7-mm Viabahn endograft more proximally to achieve an adequate seal, which required 7-F sheath access.

Rather than upsize in the brachial artery, we now accessed the right common femoral artery instead. Through that access, we introduced a 7-F X 90-cm sheath into the left subclavian artery. We deployed a 7-mm Viabahn endograft more proximally, overlapping the previously placed 6-mm graft (Figure 3). Angiography showed resolution of the type I endoleak; however, the pseudoaneurysm sac was still filling briskly through a transected branch vessel (Figure 4). A large branch artery originating from the distal axillary system was collateralizing this transected branch vessel. We catheterized the axillary branch with a 0.035-inch Glide catheter (Terumo Interventional Systems, Inc., Somerset, NJ). We confirmed direct filling of the pseudoaneurysm (Figure 5). We sub-selected the pseudoaneurysm using a Renegade microcatheter (Boston Scientific Corporation, Natick, MA), which we placed through our 0.035-inch Glide catheter. We deployed two 3-mm Interlock microcoils (Boston Scientific Corporation) into the pseudoaneurysm (Figure 6).

Completion angiography demonstrated repair of the brachial artery, with no filling of the pseudoaneurysm (Figure 7). The patient had palpable brachial and radial

Figure 4. Pseudoaneurysm filling from collateralized axillary branch.

Figure 5. Catheterization of axillary branch.

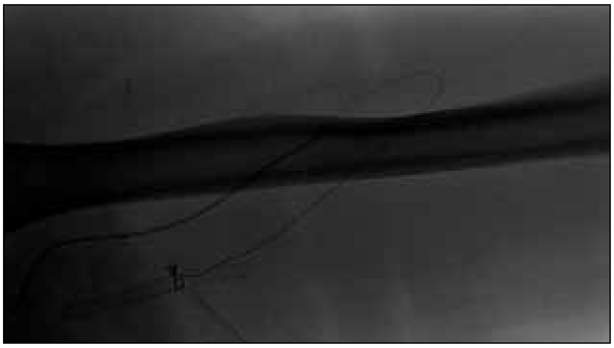

Figure 6. Coil deployment into the transected branch feeding a pseudoaneurysm.

Figure 7. Successful repair of the brachial artery.

pulses at the end of the procedure. The femoral puncture was closed with a Mynx closure device (AccessClosure, Inc., Mountain View, CA), and the brachial puncture was hemostatic after manual compression for 20 minutes. The wound was irrigated with butadiene, and the patient was placed on a 7-day course of oral antibiotics. Antiplatelet therapy was initiated with aspirin and clopidogrel. He was discharged on postprocedure day 1. At the 2-week follow-up appointment, the patient was doing well, with normal upper extremity pulses and neurologic function and good healing of his stab wound.

DISCUSSION

Endovascular techniques for repair of vascular trauma have evolved their way into the armamentarium of vascular surgeons. In this particular case, open surgical repair would have involved an axillary incision in the upper arm to explore the injury. Control of the proximal brachial artery would have required dissection through a substantial hematoma and recognition of the branches of the brachial plexus in a traumatic field. In the event that the artery was not suitable for direct suture repair, saphenous vein would have been harvested for a local vein patch or, if the brachial artery was entirely not salvageable in that position, a bypass from the infraclavicular axillary artery to the more distal brachial artery. Endovascular repair was therefore chosen for this patient due to the anticipated hazardous dissection in the axilla and potential for iatrogenic nerve injury. Moreover, endovascular repair in this circumstance preserved the opportunity for bypass in the immediate situation, as well as long-term.

Planned follow-up will include routine arterial duplex imaging every 3 months for the first year, every 6 months for years 2 and 3, and annually thereafter. If issues such as stenosis or migration arise on follow-up testing, we have still maintained the option for both endovascular and open surgical secondary interventions.

Endograft-related stenosis or occlusion in the setting of repair of traumatically injured extremity vessels can occur but has not been largely evaluated.[1] In the context of peripheral arterial disease, however, endograft placement for TASC C and D femoropopliteal occlusive lesions has yielded 4-year secondary patency rates approaching 80%.[2] For popliteal artery aneurysms, the 6-year secondary patency rate has been observed at > 85%, which was not statistically different from open surgical bypass.[3] I suspect that in acutely injured arteries without chronic disease, the long-term patency rates for endovascular treatment should be even greater. Infections of stent graft material pose a separate risk, and that risk is certainly heightened in the setting of penetrating trauma. When considering endovascular repair with stent grafts, the surrounding area should be free of gross contamination. We placed the patient on a 7-day course of prophylactic antibiotics and local wound care, and the patient has thus far avoided an infectious complication.

CONCLUSION

In summary, endovascular repair can provide decreased morbidity that can be related to surgical exposure of vascular injuries and perhaps less acute blood loss and tissue trauma, which are particularly important in those patients who are critically ill. These potential gains are pared by the higher likelihood of further interventions, the need for more aggressive antiplatelet therapy, and the potential for prosthetic infections. In select patients, however, endovascular repair can offer significant benefits despite these risks. ■

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